Chapter Comm 23

Subchapter I — Scope

Note that a change to the boiler code Comm 41.02(1) on December 1, 2008 made installation of new outdoor wood-fired boilers that serve UDC dwellings fall into the scope of the UDC regulation.

Subchapter II — Design

23.02 Sizing of Heating Equipment

Note that the outdoor air design temperatures for heat loss calculations shall be taken from the figure in the UDC Appendix or from within the Rescheck software. Indoor design temperatures is established in s. Comm 22.40 as being 70 degrees for heated areas.

23.02(3)(a) Exhaust Fan Termination

Question: Can an exhaust fan terminate inside a garage, crawlspace or attic near a vent?

Answer: No. It must have an exterior termination. The air currents may otherwise draw the exhaust back into the space. It is recommended that where exhaust terminates in the soffit space of an overhang, the soffit been "blanked-off" for a recommended 2' distance on either side of that termination unit.

23.02(3)(b) Balancing of HVAC Equipment

Question: What does "balanced" mean?

Answer: It means that the ventilation system should not produce excessive positive or negative pressures in the dwelling. Excessive negative pressure can cause chimney or vent back-drafting of combustion products or even carbon monoxide poisioning. Commentary from Comm 22 deals with leaking of buildings and the moisture that moves into or out of a dwelling, see those comments for related balance issues.

23.02(3)(b)2. Outside Air Intake Sizing

Question: How do I size the outside air intake to balance my dwelling's exhaust.

Answer: The minimum amount of make-up air must be 40% of the total exhaust. Size the duct considering the minimum and maximum flowrate conditions specified in s. Comm Table 23.07, Duct Velocities. Per this table, the minimum duct velocity is 500 ft/min and maximum allowable is 800 ft/min for outside air intakes.

Example: **Determine size of make-up air duct required for these exhaust systems.**

Range hood	=	180 cfm (intermittent)	x	40%	=	72 cfm
Bath exhaust 1	=	50 cfm (intermittent)	x	40%	=	20 cfm
Bath exhaust 2	=	75 cfm (intermittent)	x	40%	=	30 cfm
TOTAL		305 cfm (intermittent)	x	40%	=	122 cfm

Based on the formula of Quantity = Velocity times Area (Q=VA). THEREFORE:...

Check Minimum Duct Size of A=Q/V, or A=122/800, or A=0.1525 sq. ft. x 144 = 21.96 sq. in. (required)
Try 4" round duct = 3.14 x radius squared = 3.14x2x2 = 12.56 sq. in. (too small)
Try 6" round duct = 3.14 x radius squared = 3.14x3x3 = 28.26 sq. in. (OK since >21.96 in^2)
Check maximum duct size A = 122/50 = .244 x 144 = 35.136 sq. in. (therefore 6" round duct is OK since it is smaller than this)

Not doing the calculation described above to appropriately size the air intake may result in an oversize intake and cause the problems noted in s. Comm 23.07. The HVAC system shall be tested by the installer per Comm 23.18 to make sure the design amounts of air are actually provided when the system operates.

23.02(3)(d) Ductless Recirculating Fans

Question: Are there any department-approved ductless recirculating bathroom fans that may be used in lieu of natural ventilation or mechanical ventilation?

Answer: No. In rooms with a toilet, tub, or shower, it is required by (3)(d) that mechanical exhaust fans, ducted to outside the dwelling, be installed even where openable windows are present. The only exception is for dwellings without electrical service.

Subchapter III — Heating Equipment

23.03 Selection of Equipment

See s. Comm 23.02 regarding sizing of heating equipment.

23.04 Listing of Equipment

All heating equipment including woodstoves and decorative gas appliances (gas fireplaces) must be listed by a recognized testing agency. An important part of inspecting an appliance's installation is to check against its listed installation requirements. Therefore, it is good practice to refer to the installation manual when installing and inspecting the installation. Per s. Comm 23.18(1), an appliance's manual is required to be left with the owner. Per s. Comm 20.09, it can be required for plan review or inspection by the inspector.

23.04(2)(b) Unvented Furnaces and Space Heaters and Fireplaces

Portable kerosene and other types of unvented heaters are being advertised and sold in Wisconsin. However, neither the Commercial Building Code nor the Uniform Dwelling Code permit their use, even if provided with oxygen depletion sensors. Use of such heaters is prohibited because the heaters are not vented and can cause a buildup of carbon monoxide and moisture in the room. Further, the heaters require frequent refueling which can lead to spillage and additional fire hazard.

Question: If unvented heaters are prohibited by the UDC and the Commercial Building Code, why are kerosene, natural gas, alcohol fueled heaters still being sold?

Answer: These heaters are not necessarily illegal in structures not covered by either code, such as pre-1980 dwellings or agricultural buildings. However, some municipalities have adopted ordinances prohibiting unvented heaters in pre-1980 dwellings or other buildings.

Question: Can an unvented heater be used in a residential garage?
Answer: Only in detached garages, since the UDC Comm 20.07 (35) defines an attached garage as part of the dwelling. Therefore, the attached garage would have to comply with all chapters of the UDC. Most municipalities have their own ordinances of codes covering construction of accessory buildings, such as detached garages.

23.04(5) Dual Use Water Heaters

See the checklist at the end of this chapter for code issues relative to water heaters used for potable and space heating purposes.

23.04(6) Location

Question: How do I determine if a furnace is listed for installation in a bedroom, bathroom, closet or garage?
Answer: Although this information may not be shown on the unit, it does need to be covered in the installation instructions which must be provided to the owner, per s. Comm 23.18. Many times these installation instructions reference NFPA-54, National Fuel Gas Code for garage installation procedures.

Question: Since this section limits location of furnaces in a garage, can a wood stove or other space heater be located in a garage?
Answer: Not unless listed for such use. See s. Comm 23.045(2)(b).

Question: Can a furnace be located in an attic?
Answer: Yes, if within the manufacturer's listing requirements. The following UDC requirements and typical manufacturer's requirements would usually apply:

- Provide attic access opening large enough for the appliance.
- Provide combustion air per s. Comm 23.06.
- Maintain manufacturer's and UDC clearances to combustibles and clearances for servicing.
- Provide lighting for servicing the appliance.
- Provide a solid walkway to the appliance and solid platform under and around the appliance for servicing.
- The attic framing must be designed to support the furnace and servicing loads.
- Isolate the appliance from any loose insulation that could enter the combustion chamber.
- Isolate the appliance from any drafts caused by power attic venting of the attic.

Also, the furnace must be able to withstand freezing temperatures which may adversely affect condensing-type furnaces.

23.045 Solid-Fuel-Burning Appliances

Effective February 1, 1989, solid-fuel-burning appliances had to be tested, listed and labeled by an accepted testing agency. (See s. Comm 21.32 commentary for approved agencies.)

At the time the Dwelling Code was first written (1980), nationally recognized standards on solid-fuel-type appliances were not available. Since that time, Underwriters' Laboratories have developed standards for testing and listing solid-fuel- burning appliances. Most models on the market are now tested, listed and labeled by approved independent agencies. When a specific installation instruction approved by the testing/listing agency is more or less stringent than s. Comm 23.045, then the listing agencies instructions govern.

23.045(3)(b) Co-venting of Solid-Fuel Appliances

Note that this section does not allow co-venting of solid-fuel appliances. Each fireplace, woodstove, or other solid-fuel appliance must be vented to its own flue.

23.045(4) Chimney Connectors

Question: Does a solid fuel appliance in front of an existing fireplace opening require a chimney connector?

Answer: Usually, for proper operation, a smokepipe is needed from the appliance outlet to the opening of the actual chimney flue per its listing. Additionally, a factory-built fireplace's listing must be compatible for such an alteration.

23.045(6) Appliance Clearances

The requirement for proper clearances in this section refers to clearances to combustibles. It should be remembered that an appliance still needs to comply with s. Comm 23.045(2) for the proper servicing clearances.

A wood-frame wall with gypsum board or plaster finish is still considered a combustible wall for determining appliance and smokepipe clearances. Heat is readily conducted to the studs underlying the gypsum board. Over a period of time, the ignition temperature of the wood decreases as it is dried out and chemically changed. Noncombustible surface protection is only effective if there is at least a 1-inch air space between it and the combustible construction.

23.045(10) Combination Appliances

Note that this section requires combination appliances or dual-fuel appliances to be listed for the combination use. If allowed by the listing, the units may be vented by the same flue.

Table 23.045-C specifies the floor mounts for solid-fuel-burning appliances.

23.06 Combustion Air for Wood Stoves

Question: Comm 23.06(2). How do I calculate if a wood stove needs outside combustion air because of small room size?

Answer: If the appliance is listed, then an hourly input rating is given and the calculation is straightforward. An unlisted appliance's hourly input BTU rating can be figured on the following basis:

$$\frac{\text{BTU input}}{\text{hr.}} = C \times 60\% \text{ (\% firebox fill)} \times \frac{40 \text{ lbs. wood}}{\text{cu. ft.}} \times \frac{8600 \text{ BTU}}{\text{lb. wood}} \times \frac{1 \text{ fireboxfull}}{2 \text{ hrs.}}$$

$$= \frac{103{,}200 \text{ BTU/HR}}{\text{cu. ft.}} \times C$$

where: C = firebox capacity (cu. ft.) = l x w x h
= product of inside firebox dimensions in feet.

23.06 Combustion Air

The code offers several methods to supply adequate combustion air. Below is a highlighted listing of the options. Also see the optional Makeup and Combustion Air Worksheet at the end of this chapter.

Method 1. Inside Air (Discontinuous Vapor Retarder) [23.06(3)]: Allows combustion air to be drawn from an inside space if the building has a discontinuous vapor barrier, as is permitted at boxsills or below grade walls by s. 22.38(2)(c). The space shall provide a room volume of at least 50 cubic feet per 1000 btu/hr combined input rating of all open combustion appliances in that space. An inside space may include several rooms if connected with high and low openings, with each opening providing one square inch of clear opening per 1000 btu/hr input rating, but not less than 100 square inches each.

Method 2. Inside & Outdoor Air (Continuous Vapor Retarder) [23.06(4)(d)]: If a building has a continuous vapor barrier, and therefore cannot use the method of 23.06(3) of taking all air from inside, but does have a room volume of at least 50 cubic feet per 1000 btu/hr combined input rating of all open combustion appliances in that space, then it can use a method of supplementing the inside air with outside air. It shall be via a single, direct or ducted, exterior, high opening, sized at one square inch per 5,000 btu/hr combined input rating.

Method 3. Single Outdoor Opening (Gas Appliances Only) [23.06(4)(c)]: If serving only gas appliances, then from outdoors via a single, direct or ducted, exterior, high opening sized at one square inch per 3,000 btu/hr combined input rating, but not less than the combined cross sectional areas of the appliance flue collars or draft hood outlets in that space.

Method 4. Prorated Inside Air Credit Plus Outdoor Air [23.06(2)(d)]: For method 1, per current national standards [2006 NFPA 54-9.3.4], we will also allow a combination of drawing inside and outside combustion air, unless prohibited by the appliance manufacturer. This is done by taking a pro-rated credit for an inside space that partially meets method 1, and then making up the difference by pro-rating the outside combustion air otherwise required by Method 5 [23.06(4)(c)]. Example: If the inside space provides only 25 cubic feet per 1,000 btus, or half of the size required by method 1, then the additional direct or ducted outside combustion air, as calculated by method 5 can be reduced by one half.

Method 5. Two Outdoor Openings [23.06(4)(b)]: From outdoors via high and low direct or vertically ducted exterior openings, each sized at one square inch per 4,000 btu/hr combined

input rating or via horizontally ducted openings, each sized at one square inch per 2,000 btu/hr combined input rating.

EXAMPLE:

1. Determine if the space in which the heating appliances are located is large enough to supply combustion air by itself per Method 1 pers. Comm 23.06(3).

    a. The plans indicate a utility room will be constructed which houses a:
    (1) Gas-fired furnace (100,000 BTU input).
    (2) Gas-fired water heater (33,000 BTU input).

    b. The utility room size is approximately 12 ft. long by 5.5 ft. wide. This is 66 sq. ft. in area. The rest of the basement is 934 sq ft. in area.

    The "Typical Section" drawing shows the room height to be 7 ft. 6 in. plus the depth of the floor joists 9 1/4 in. Therefore, the height then becomes 8.27 ft. The section also indicates that the vapor retarder is omitted on the boxsill, so s. Comm 23.06(3) may be used.

    The volume of the room equals 66 sq. ft. times 8.27 ft. or 545 cu. ft.

    c. The minimum room volume on the basis of the equation in s. Comm 23.06(3) is:

    $$\text{Volume} = \frac{\text{100,000 BTU furnace + 33,000 BTU water heater}}{1{,}000} \times 50 \text{ cu ft} = \text{6650 cu. ft.}$$

    Since the 545 cu. ft. is smaller than 6650 cu. ft., the utility room is too small and another method of supplying combustion air must be used.

2. Try Method 1 again, but draw combustion air from the whole basement via openings in the utility room walls.

    a. The volume of the room equals 1000 sq. ft. times 8.27 ft. or 8270 cu. ft. which satisfies the calculated required volume of 6650 cu ft above.

    b. Two openings are required (high and low), each sized as follows:

    $$\text{Opening Area} = \frac{\text{(100,000 BTU + 33,000 BTU)}}{1{,}000} = 133 \text{ sq. in.}$$

    c. This also satisfies the requirement for a minimum 100 sq in openings. (Two 1-sq. ft. = 144 sq.in. openings would suffice.)

OR

3. Try Method 3 per s. Comm 23.06(4)(c) single outdoor opening between the utility room and the exterior. Since the appliances are all gas-fired, this method may be used. (We could take a prorated credit per Method 3 of s. Comm 23.06(2)(d) for the utility room, but because of it smallness, we will not bother in this example.)

   a. The minimum size of the single opening is determined as follows:

      $$\text{Opening Area} = \frac{133{,}000 \text{ BTU}}{3{,}000} = 44 \text{ sq. in.}$$

   b. An 8" round duct, which provides 50 sq in, would satisfy this. However, you must also check that the combined flue collar areas of the appliances would be met:
      The water heater has a 3" diameter collar which is $3.14(1.5^2) = 7$sq in. in area.
      The furnace has a 6" diameter collar which is $3.14(3^2) = 28$ sq in. in area.
      The combined area is 7 sq in + 28 sq in = 35 sq in - OK

   c. Consideration should be given to the blocking effect of screens and louvers in air intake openings. Assuming 1/8" screen, multiply the 50 sq in of the 8" diameter duct by 0.8 to arrive at 40 sq. in., which is too small and must have a transition to something like a 8" x 8" square termination of steel louver [thus 48 in^2 = 64 in^2 x 0.75 louver factor per Comm 23.06(5)(c)] which still satisfies the requirement.

Subchapter IV — Delivery Systems

23.07 Duct Sizing

Table 23.07 sets minimum and maximum air velocities in ducts. Meeting minimum duct sizes reduces air noise, occupant discomfort and fan inefficiencies. Meeting maximum duct sizes economizes on materials, provides adequate air throw at outlets and may help fan efficiency.

See the commentary under 23.02 for an example of duct sizing calculation.

23.08(1) Ducts Used for Other Purposes

Question: Can electrical, telephone or cable TV wiring be run through air return or supply ducts? Can supply ducts be run through air return ducts or joist spaces used as returns?

Answer: No, with three exceptions per National Electrical Code 300-22:

- Teflon-insulated wiring.
- Metal enclosed wiring.
- Romex wiring run perpendicularly to the length of a joist or stud space used as a return air plenum.

The department will also allow water and waste piping run perpendicularly through a duct if no pipe joints or cleanouts are within the duct. All penetrations have to be sealed to maintain duct pressures and prevent air leakage. In addition the size of the penetrating utility through the duct can **NOT** effect the velocity or capacity of the duct to transmit the required air volume of the duct.

23.08(4) Underground Ducts

Also applicable to underground ducts is s. Comm 22.42 which requires R-8 insulation. The more restrictive requirement controls.

23.08(7) Duct Support

Table 23.08-B was revised in 2009 to clarify the support of rigid ducts, including hanger options.

Question: Is there a maximum length of "flex-duct" that is allowed by the Code?

Answer: No, many people feel that since the Commercial Code limited duct length, the UDC also should. There is no maximum length in the code; however, you must not exceed the static pressure loss in Table 23.07 for air distribution systems. Therefore, from a practical standpoint, flex-ducts will need to be less than 10-14 feet. In no case shall the minimum/maximum velocities **or** the maximum static pressures be exceeded. Also note that there is a listing [and price] difference between flex-duct and flex-connector, which are tested to different standards and have different material limitations. For example the current commercial code does not limit flex-duct length, however flex-connector does limit installed length at 14'.

For exhaust fans, it may be necessary to increase the fan capacity if the static pressure is excessive due to a restrictive duct system. This is not to say that adequate support of flex-duct or flex-connectors should be ignored, as the listing for these products do have maximum bend radius and acceptable dip limitations.

23.09(1) Volume and Backdraft Dampers

Register dampers **do not** satisfy the requirement for volume duct dampers due to their looseness.

If duct volume dampers will be concealed behind finish materials, access panels shall be provided to allow future adjustment. Alternatively, dampers may be placed behind registers, which could be removed for future access to the dampers. This is now a requirement listed in Comm 23.09(1)(b) to have access to the dampers for adjustment at later times.

23.09(2)(b) Return Air Openings

Question: Is it necessary to have a return air opening in each room that has a supply air opening?

Answer: No. If doors are undercut or other air transfer means are provided, it would not be necessary to have a return air opening in each room. However, the air must at least be transferred to a return duct serving the same floor level.

Question: In a two-story house, may a return air grille, at the base of the stairs to the second floor, serve the second floor? (Can the stairway serve as a return air system?)

Answer: No. Per this code section there must be return grilles located on both floors.

23.10(1) Solar System Piping

Question: Can PVC (plastic) piping be used in a solar wet-heat system?
Answer: Section Comm 23.10 addresses the subject of piping for wet-heating systems. However, this section does not speak specifically to the kind of piping materials. It only says that the material shall accomplish the calculated results without stress or other detriment.

This section is also supplemented by s. Comm 71.25, Liquid Systems, of the Solar Energy Systems Code which became effective July 1, 1986. The Solar Energy Systems Code includes voluntary construction quality standards for solar collectors and their supporting mechanical systems.

Section Comm 71.25 does allow plastic piping for some systems if the material meets s. Comm 84.30 of the Plumbing Code.

Subchapter V — Chimneys and Vents

23.11(1) Summary of Common Vent and Chimney Types.

Classification	Other names	Cont. ^{o}F	Max. ^{o}F	Use	Clearance
1. Single-wall metal pipe	Class C	--	--	Only as connector in residence	Per Comm 23.045 and 23.15
2. BW vent	--	550^{o}	--	Wall furnace (2"x4" wall)	Per listing
3. B vent	Gas vent	470^{o}	--	Listed gas appliance with hood	B-1" to B-3" B-2"x 4", B-2"x 6"
4. L vent	Oil vent	570^{o}	--	Gas or oil appliance per listing	L-1" to L-3"
5. Residential type factory-built chimney	Class A All-fuel Solid-fuel Metal Chimney				
a. Standard		1000^{o}	1700^{o}	Gas, oil and solid fuel appliances except closed-chamber solid fuel appliances	1" – 2"
b. HT (high temperature)		1000^{o}	2100^{o}	Includes closed chamber solid-fuel appliances	1" – 2"
6. Masonry chimney with liner	--	(1000^{o})	1800^{o}	Includes closed chamber solid-fuel appliances	1" – 2" 21.30(9)
7. Factory-built fireplace and chimney package	--	--	--	Per listing	Per listing

23.11(1) Power Venters
Question: Can power-vented appliances be used?
Answer: Yes. There are two types of power-vented appliances. One type is designed, manufactured and listed as a unit. These are installed per their listing.

The second type is an add-on power venter designed and manufactured by a manufacturer other than the appliance manufacturer. These units must either be tested and listed for connection to specific appliance types.

Co-venting with either type must be done strictly per their listing because of possible backdrafting and variable pressure conditions.

23.11(2)(b) Horizontal Vent Termination

Question: What is required for vent sizing when multiple appliances share a common vent and equipment is changed or replaced?

Answer: Gas vents are to be sized for the appliances **currently** connected to them. Therefore, if the new equipment is either larger or smaller, the common vent may have to be altered in size. This applies replacement equipment.

23.13 Physical Guarding of Chimneys and Vents

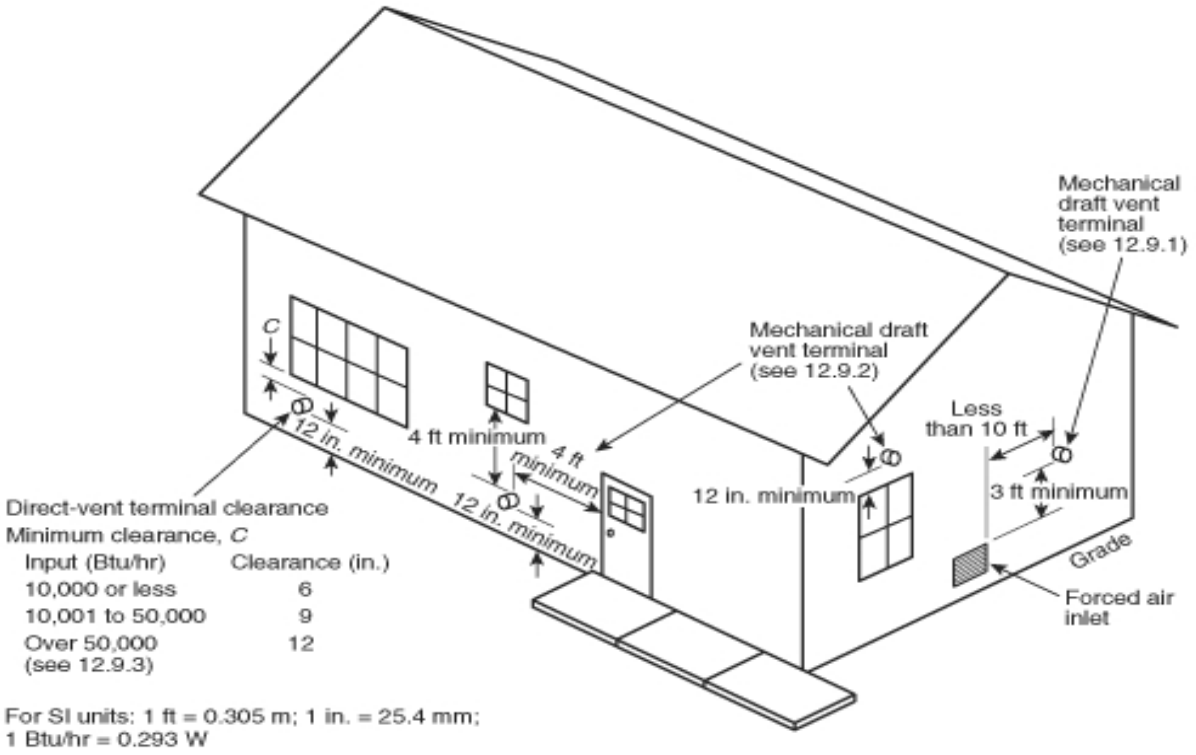
Question: Does an accessible chimney or vent need to be guarded against physical damage when located in a space like a garage?

Answer: Yes, normally a metal chimney usually does require to be guarded as part of its listing. A metal vent may require guarding as part of its listing.

23.14(2) Dryer Venting

Question: May plastic vent pipe or flex-vent be used for clothes dryers?

Answer: Probably not. Comm 23.14 (2) requires gas-fired clothes dryers to be vented to the exterior with metal vent pipe. If the vent piping is concealed, then it shall be rigid metal. Most manufacturers of even electric clothes dryers also recommend metallic vents; however, some still allow plastic vents to be used.. Due to various safety and fire hazards, the department recommends metal for all dryers that way if equipment is changed out later to a gas dryer it would still be compliant.



Exit Terminals of Mechanical Draft and Direct-Vent Venting Systems.

Above diagram is gas vent terminal clearances from the Appendix of NFPA 54 standard.

Subchapter VI — Fuel Supply Systems

23.16(1) LP Gas Storage Tanks

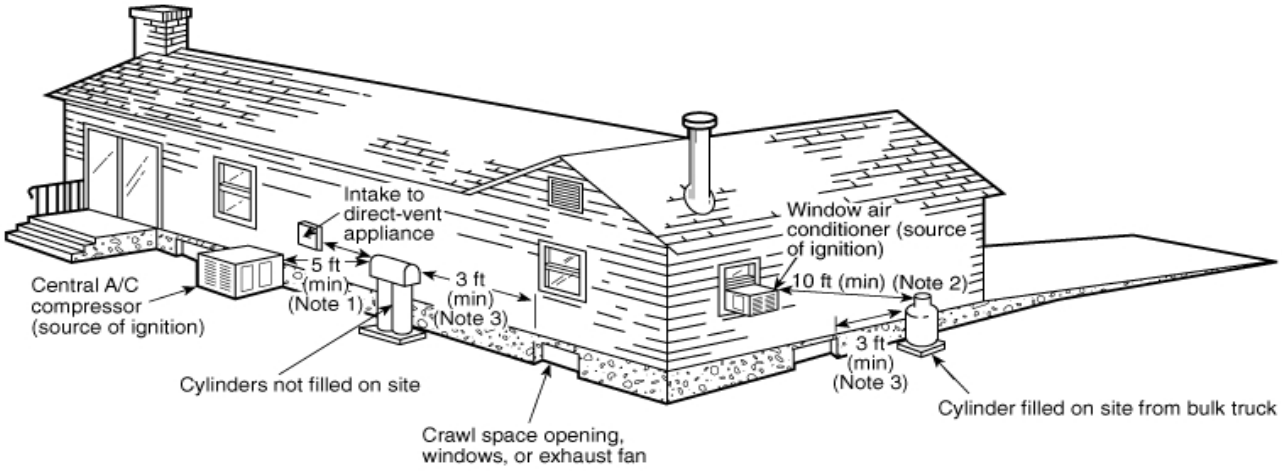
Section Comm 23.16(1) states that LP gas tanks are subject to Ch. Comm 40, LP Gas Code. That Comm 40 adopts NFPA 58 – 2004, Standard for the Storage and Handling of Liquefied Petroleum Gases, which is summarized below. (Piping after the first stage regulator, with some exceptions, is subject to NFPA 54, National Fuel Gas Code which is adopted by s. Comm 20.24). We recommend you purchase the actual codes from NFPA at address shown in Table 20.24-10.

The following NFPA 58 and Comm sections summarize this section.

NFPA 58	Comm	
	40.43	Installer of a tank or tanks of 125 gallon or larger capacity shall have certificate of installation form SBD 9656 and if over 2000 gallons shall notify the local fire department within 10 days.
[6.3.1]		See attached excerpted table and figures for minimum distances between tanks and nearest other tank, important building or adjoining property line.
[6.2.1]	23.16(1)(b)	No LP tanks inside dwellings.

[6.4.5.2]		Loose or piled combustible material and weeds not permitted within 10 feet of tank.
[6.6.3.1]	23.16(1)(c)	Tanks to have welded steel supports and to be installed on concrete pads or foundations.
[6.4.5.3]		No barriers around tank to trap leaked gas or to impede firefighting.
[6.6.1.2]		Tank protected against damage by vehicles where likely. (Four-foot tall concrete filled 6-inch steel posts are acceptable.)
[6.6.1.4]		Tanks to be properly painted.
[6.7.4.3]		First stage regulators to be as close as possible to the container and outside of buildings.
[6.7.2.10]		Install first stage regulator downstream of tank shutoff valve.
[6.7.4.4]		Regulators to be securely anchored. Regulator outlet to be protected to prevent entry of ice, snow or debris.
[6.7.4.5]		Regulator outlet to at least 3 feet horizontally away from any building opening below the level of such outlet.
[6.7.4.6]		Min. 5' between pressure regulator and sources of ignition.

Figures below are from Appendix of NFPA 58-2004 standard.

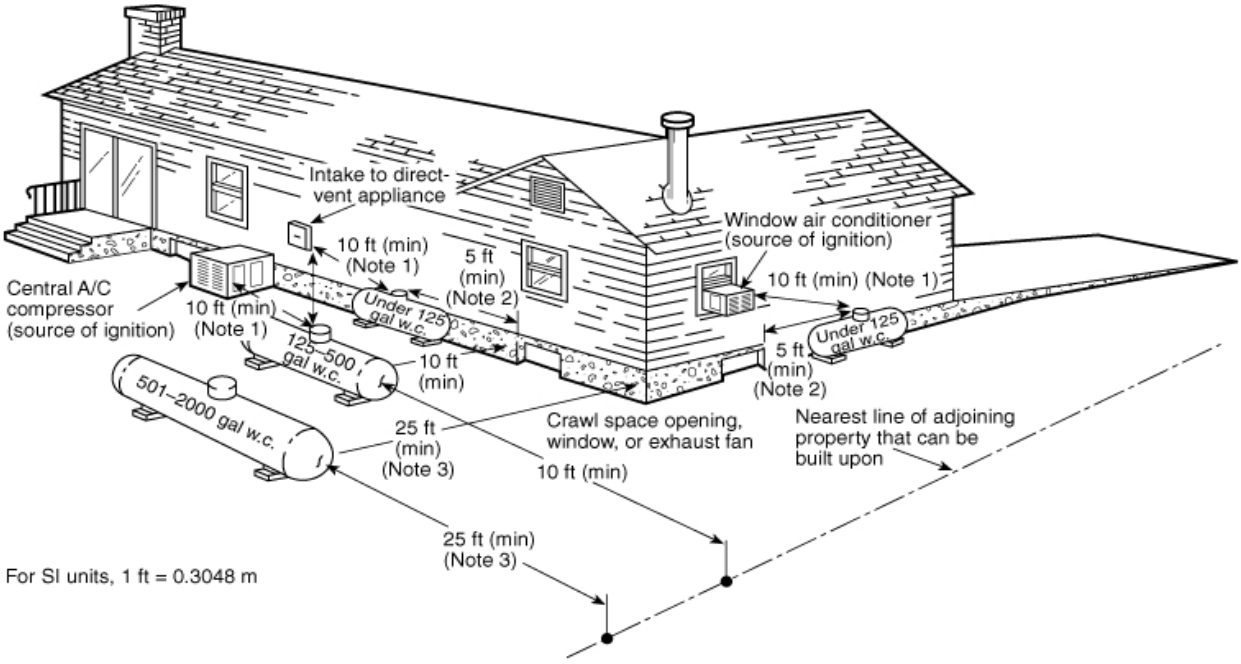


For SI units, 1 ft = 0.3048 m

Note 1: 5-ft minimum from relief valve in any direction away from any exterior source of ignition, openings into direct-vent appliances, or mechanical ventilation air intakes. Refer to 6.3.7.

Note 2: If the cylinder is filled on site from a bulk truck, the filling connection and vent valve must be at least 10 ft from any exterior source of ignition, openings into direct-vent appliances, or mechanical ventilation air intakes. Refer to 6.3.9.

Note 3: Refer to 6.3.7.



For SI units, 1 ft = 0.3048 m

Note 1: Regardless of its size, any ASME container filled on site must be located so that the filling connection and fixed maximum liquid level gauge are at least 10 ft from any external source of ignition (e.g., open flame, window A/C, compressor), intake to direct-vented gas appliance, or intake to a mechanical ventilation system. Refer to 6.3.9.

Note 2: Refer to 6.3.9.

Note 3: This distance may be reduced to no less than 10 ft for a single container of 1200 gal (4.5 m^3) water capacity or less, provided such container is at least 25 ft from any other LP-Gas container of more than 125 gal (0.5 m^3) water capacity. Refer to 6.3.3.

23.16(2) Oil Storage Tanks

Section Comm 23.16(2) states that oil tanks are regulated by Comm 10, Flammable and Combustible Liquids Code, which covers oil equipment and is summarized below:

Comm 10 & NFPA 31

Ch. Comm 10 adopts NFPA 31-2006, Standard for the Installation of Oil-Burning Equipment, for tank requirements, which are summarized below for inside tanks Consult the code and standard for further details.

4.3.1	Tank normally located in lowest building level
7.5.8	Minimum 5' between tank and any source of heat.
7.5.9(1)	Tank pitched 1/4" per foot to outlet.
7.5.9(2)	Shutoff required at outlet of tank.
7.5.11	Both fill pipe and vent pipe installed on tank.
7.5.11.2	Vent pipe larger than largest withdraw or fill pipe or 1¼" minimum diameter.
7.5.11	Fill pipe and vent pipe to terminate outside.
7.5.12	Gauging device required on tank.
7.5.14	Tanks provided with rigid non-combustible supports
8.2.1	Piping to be metallic.
8.3.2(1)	Fill pipe terminates at least 2' from any building opening at same or lower level.
8.3.4	Metal cover required on fill pipe.
"	Oil fill pipe to be identified.
8.7.1	Vent piping pitched to tank.
8.7.3	Vent pipe protected from physical damage.
8.7.5	Vent pipe to terminate at least 2' from any building opening.
8.7.6	Weatherproof hood required on vent termination.
8.7.5.1	Vent to terminate above snow or ice level
8.7.11	Vent to terminate at least 5' from any air inlet or flue gas outlet of any appliance.
8.8.3	Gauge to visually or audibly tell tank filler when tank is full.
8.9.1	Piping to be tested.

23.16(2) Gas Piping Systems

This National Fire Protection Association Standard (NFPA) Standard 54 – 2006 is adopted by the code for gas piping installation only. The requirements of the National Fuel Gas Code are summarized below.

Question: Is copper piping for natural gas permitted within a dwelling?

Answer: Yes, if, per s. 5.6.2.3 of NFPA 54, there are no more than 0.3 grains of hydrogen sulfide per 100 cubic feet of gas. To this department's knowledge, all gas delivered to Wisconsin meets this limit. Installations conforming with NFPA-54 are acceptable and comply with the UDC. Municipalities or local utilities may not require the use of only black iron pipe if the installation complies.

NFPA 54-2006

Part 1 General

1.1.1.1	Code applies from point of delivery to gas utilization device for both natural and LP gases. ["Piping" includes pipe (rigid) and tubing (flexible).]

Part 5 Design, Materials and Components

5.4.1	Piping sized to provide an adequate supply of gas - see following tables.
5.6.2	Acceptable pipe - steel (black or galvanized), wrought iron, copper*, brass*, aluminum alloy (aboveground interior only).
5.6.3	Acceptable tubing - copper* (Type K or L), aluminum alloy (aboveground interior only), steel. *Max. 0.3 grains of hydrogen sulfide/100 ft.^{3} (Wisc. okay).
5.6.4.1	Plastic pipe and tubing acceptable for underground exterior uses only. (Plastic LP gas piping per NFPA 58.)
5.6.8	Acceptable joints and fittings.
5.6.8.1 5.6.8.2	- Pipe - threaded, flanged, brazed, welded, flared (nonferrous). - Tubing - AGA approved tubing fittings, brazed (1000 DF min., no phosphorous), flared.
5.6.7.4	Pipe dope or tape on threaded joints unless not required by fitting manufacturer.
5.7.2.3	No sources of ignition (electrical equipment, flue gas exhausts, combustion air intakes, etc.) within 3 feet of gas meters.
5.8.5.1(1)	Interior pressure regulators to be vented outside or vent-limited.
5.8.5.2	Per NFPA 58, s. 6.7.4.5, LP gas regulator to be vented so outlet is no less than 3 feet horizontally away from any building opening below the outlet.
5.12	Listed shutoff valves

Part 7 Installation

7.1.2.1	Underground piping to have 18" cover, 12" if not subject to hazard.
7.1.5	Underground piping to be sleeved and caulked at foundation entrance.
7.1.6.1	Piping underneath buildings in a conduit vented to outside and sealed at building entrance.
7.2.1	Aboveground exterior piping securely supported and coated or wrapped at foundation entrance.
7.2.5	Piping okay in accessible above-ceiling spaces, including plenums, but no valves allowed.
7.2.5	Piping not allowed in: - Circulating air ducts. - Clothes chute. - Chimney or gas vent. - Dumbwaiter or elevator shaft. - Ventilating duct, but okay in combustion air duct.
7.2.6.2	Piping support on center spacing: - Pipe – ½" - 6', - ¾" or 1" - 8'; - 1-¼" - 10' - Tubing – ½ " - 4'; - 5/8" or 3/4" - 6'; - 7/8" or 1" - 8' Vertical piping must be supported a minimum at each floor.
7.3.2	Following fittings <u>not</u> allowed in concealed piping: - Unions. - Tubing fittings, except by brazed fittings. - Compression couplings made by combination of fittings. - Right-and-left couplings. - Bushings. - Swing joints.
7.3.2(4)	Reconnection into existing concealed piping: - In pipe by welding, flanges, or ground joint union with center punched nut to prevent loosening by vibration. - Not allowed in tubing.
7.3.3	Piping not allowed in solid (such as concrete) partitions.
7.3.4	Tubing, if not rigidly secured, can be concealed in partitions if protected against nail penetration with 0.05” thick or 16 gauge sheet metal or equivalent at penetrations of studs, plates and

	firestops and 4" beyond.(Note that per CSST standard, protection is for 5" beyond member.)
7.3.5.2	Piping in slab floors to be laid in channels with removable covers or must have minimum 1-1/2” concrete around them.
7.7.1	Outlets:
7.7.1.2	- Not allowed behind doors.
7.7.1.4	- Unthreaded portion of pipe to protrude at least 1" out of walls and ceilings and
7.7.1.5	- 2" above floors (quick connect devices exempt).
7.7.2.1	- To be capped when not used.
7.9.1	Gas shutoff valve required upstream of pressure regulator.
7.9.2.2	Exterior shutoff valve required at each building served.
7.13.1	Piping to be electrically continuous and bonded to any grounding electrode (may use equipment grounding conductor) but not to be used as a grounding electrode.

Part 8 Testing

Installer shall test system at the greater of 3 psi or 1-1/2 times working pressure for at least 10 minutes prior to putting in service. If pressure drop is detected, then joints shall be tested with gas detector, soap and water or equivalent nonflammable solution

Part 9 Equipment (Connections to Piping)

9.1.17	Equipment supported not to strain piping or connections.
9.6.1	Equipment connectors allowed:
9.6.1(1)	- Rigid pipe.
9.6.1(2)	- Tubing.
9.6.1(3)	- Listed connectors (in same room only and where not subject to damage).
9.6.1(4)	- Listed hose connector (outdoors only).
9.6.1(6)	- Listed nonmetallic gas hose connectors.
9.6.4	Equipment shutoffs:
9.6.4.1	- Within 6' of appliance.
9.6.4.1(1)	- Upstream of connector.
9.6.4.1(1)	- Union downstream of valve.
9.6.4.1(2)	- Decorative appliances in fireplace, if listed for that use.

9.6.7 Sediment trap required at all appliances except lights, ranges, dryers, gas fireplaces and outdoor grilles.

9.6.8 Piping not to interfere with appliance servicing (24" away from access panels).

Sizing Gas Piping

1. Determine appliance gas demand from name plate or the following Table C-1.

   - Natural Gas - Use cubic feet per hour which equals BTU input divided by average BTU heating value per cubic foot of gas (typically 1000 BTU per cubic foot).

   - LP Gas - Use BTU input.

2. Measure the length of piping from point of delivery to the most remote outlet in the building.

3. Using the appropriate table, select the column showing the measured length or next longer length. This is the only column that will be used for the whole system.

4. In the selected column, find the gas demand, or next higher demand, of the most remote outlet and piping section.

5. Opposite this demand figure, find the correct gas piping size in the far left column.

6. Proceed in a similar manner for each outlet and each section of gas piping using the same column. For each piping section, determine the total gas demand supplied by that section.

Table C-1

Approximate Gas Input for Typical Appliances

Appliance	Input BTU per hour (Approximate)
Range, Free Standing, Domestic	65,000
Built-In Oven or Broiler Unit, Domestic	25,000
Built-In Top Unit, Domestic	40,000
Water Heater, Automatic Storage	
30 to 40 Gallon Tank	35,000
Water Heater, Automatic Storage	
50 Gallon Tank	50,000
Water Heater, Automatic Instantaneous	
(2 Gallons Per Minute	142,800
Capacity (4 Gallons Per Minute	285,000
(6 Gallons Per Minute	428,400
Water Heater, Domestic, Circulating or Side-Arm	35,000
Refrigerator	3,000
Clothes Dryer, Type 1 (Domestic)	35,000
Gas Light	2,500
Incinerator, Domestic	35,000

For specific appliances or appliances not shown above, the input should be determined from the manufacturer's rating.

Table C-17

Maximum Capacity of Semi-Rigid Tubing in Thousands of BTU per Hour of Undiluted Liquefied Petroleum Gases (at 11 Inches Water Column Inlet Pressure)

(Based on a Pressure Drop of 0.5 Inch Water Column)

Outside Diameter,	Length of Tubing, Feet									
Inch	10	20	30	40	50	60	70	80	90	100
3/8	39	26	21	19	--	--	--	--	--	--
1/2	92	62	50	41	37	35	31	29	27	26
5/8	199	131	107	90	79	72	67	62	59	55
3/4	329	216	181	145	131	121	112	104	95	90
7/8	501	346	277	233	198	187	164	155	146	138

Table C-4

Maximum Capacity of Pipe in Cubic Feet of Gas per Hour for Gas Pressures of 0.5 Psig or Less and a Pressure Drop of 0.5 Inch Water Column

(Based on a 0.60 Specific Gravity Gas)

Nominal Iron Pipe Size, Inches	Internal Diameter, Inches	Length of Pipe, Feet													
		10	20	30	40	50	60	70	80	90	100	125	150	175	200
1/4	0.364	43	29	24	20	18	16	15	14	13	12	11	10	9	8
3/8	0.493	95	65	52	45	40	36	33	31	29	27	24	22	20	19
1/2	0.622	175	120	97	82	73	66	61	57	53	50	44	40	37	35
3/4	0.824	360	250	200	170	151	138	125	118	110	103	93	84	77	72
1	1.049	680	465	375	320	285	260	240	220	205	195	175	160	145	135
1-1/4	1.380	1,400	950	770	660	580	530	490	460	430	400	360	325	300	280
1-1/2	1.610	2,100	1,460	1,180	990	900	810	750	690	650	620	550	500	460	430
2	2.067	3,950	2,750	2,200	1,900	1,680	1,520	1,400	1,300	1,220	1,150	1,020	950	850	800
2-1/2	2.469	6,300	4,350	3,520	3,000	2,650	2,400	2,250	2,050	1,950	1,850	1,650	1,500	1,370	1,280
3	3.068	11,000	7,700	6,250	5,300	4,750	4,300	3,900	3,700	3,450	3,250	2,950	2,650	2,450	2,280
4	4.026	23,000	15,800	12,800	10,900	9,700	8,800	8,100	7,500	7,200	6,700	6,000	5,500	5,000	4,600

Table C-6

Maximum Capacity of Semi-Rigid Tubing in Cubic Feet
of Gas per Hour for Gas Pressures of 0.5 Psig or Less
and a Pressure Drop of 0.5 Inch Water Column

(Based on a 0.60 Specific Gravity Gas)

Outside Diameter, Inch	Length of Tubing, Feet													
	10	20	30	40	50	60	70	80	90	100	125	150	175	200
3/8	27	18	15	13	11	10	9	9	8	8	7	6	6	5
1/2	56	38	31	26	23	21	19	18	17	16	14	13	12	11
5/8	113	78	62	53	47	43	39	37	34	33	29	26	24	22
3/4	197	136	109	93	83	75	69	64	60	57	50	46	42	39
7/8	280	193	155	132	117	106	98	91	85	81	71	65	60	55

Table C-16

Maximum Capacity of Pipe in Thousands of BTU per Hour
of Undiluted Liquefied Petroleum Gases (at 11 Inches Water Column Inlet Pressure)

(Based on a Pressure Drop of 0.5 Inch Water Column)

Nominal Iron Pipe Size, Inches	Length of Pipe, Feet											
	10	20	30	40	50	60	70	80	90	100	125	150
1/2	275	189	152	129	114	103	96	89	83	78	69	63
3/4	567	393	315	267	237	217	196	185	173	162	146	132
1	1071	732	590	504	448	409	378	346	322	307	275	252
1 1/4	2205	1496	1212	1039	913	834	771	724	677	630	567	511
1 1/2	3307	2299	1858	1559	1417	1275	1181	1086	1023	976	866	787
2	6221	4331	3465	2992	2646	2394	2205	2047	1,921	1811	1606	1496

23.16(4) Shutoff Valves

Question: Can a water-type valve be used as a manual gas shutoff valve?
Answer: No. Gas shutoff valves must be approved by AGA or UL for such use. Their approval will be indicated on the valve.

Question: Is a manual shutoff device acceptable on a gas fireplace starter?
Answer: Yes. (Gas log systems shall be installed per their listing.)

Subchapter VII — Equipment Location and Operation

23.17(2) Equipment Location

Section Comm 23.17(2) requires indoor equipment to be installed with a minimum of 24 inches clearance for service. This service clearance is only required on the face(s) of the equipment with service panels. Otherwise, lesser clearances as allowed by the listing are acceptable.

23.18 Equipment Operation

Question: Balancing and testing of every HVAC system is required by Comm 23.18(2), - can the UDC inspector ask for a copy of that balancing report or pressure test?
Answer: Yes, at the final inspection a copy of that documentation should be found on site. Note that the duct sealing requirements of Comm 22.43 may be related to the testing of the ventilating system, as are toilet exhausts and make-up air supplied.

Some inspectors or owners may wish to know what sort of items should this testing and/or balancing report have included. Guidance from commercial building code Comm 64.0313 on this issue could help to be used as reference in order determine what information is required to be addressed and the means by which the information may be recorded. Included below is the note from that code section:

> *Note: National Environmental Balancing Bureau (NEBB) Procedural Standards, the Associated Air Balance Council (AABC) National Standards, the Sheet Metal and Air Conditioning Contractors National Association, Inc (SMACNA) as issued in "HVAC SYSTEMS Testing, Adjusting & Balancing" or equivalent balancing procedures are acceptable to the department.*

It is known SMACNA even provides general forms for use in balancing. Some of the forms in SMACNA are impractical for use in residences since the systems are so simple, but at least SMACNA does provide information on what information is required to be addressed, and the means by which the information may be recorded for future review by the contractor who balanced the system, the owner, as well as the UDC inspector &/or Dept. representative should there be any questions as to the performance of the HVAC system at a future time.

Summary of Rules for Water Heaters Used for Space Heating
1/12/09

Note: Chs. Comm 20-25 apply to one- and two-family dwellings built since 1980, Chs. Comm 60-66 apply to commercial and multi-family dwellings. Chs Comm 82-87 apply to all buildings.

- **Listing:** Per ss. Comm 23.04(5) and Comm 64.0301(3), water heaters used for space heating need to be listed for such use. The data plate shall indicate that the unit can be used for space heating. Note in Comm 23.04(5)(a) specifies that they be listed per ANSI Z21.10.1 or ANSI 21.10.3 [for inputs $\leq$ 75 MBH or over 75 MBH respectively]. The typical listing is for dual use, which means that in addition to the heating use, it shall also be used for potable use, which may be satisfied with at least one properly connected water fixture. Alternatively, s. Comm 64.0301(3)(b) allows unlisted equipment if a standard is cited by the manufacturer and then a Wisconsin engineer tests the appliance to it.
- **WI Boiler Code:** This code does **not** require all water appliances used for space-heating to be considered boilers and to comply with boiler standards.
- **Efficiency:** Federal appliance efficiency standards have usurped our efficiency requirements for smaller appliances for which they have developed a standard. They require that a manufacturer meet the standard applicable for the type of appliance that they market an appliance as being classified. There is a federal standard for potable water heaters. There is a federal standard for boilers, which would apply to water heaters used for space heating only. There is only a federal standard for water heaters in general, not specifically dual-use water heaters. We do not have an efficiency standard for dual-use water heaters in either residential or commercial occupancies. There is **NO** state or local responsibility or authority to enforce the federal rules.
- **Sizing:** Per s. IECC Table 404.5.2 footnote h, for multi-family housing, a dual-use water heater shall be sized by proportion for both uses with a maximum 1 hour potable water recovery period at winter design temperature for space heating. Otherwise, for UDC purposes, the appliance shall be sized and documented to provide sufficient heat.
- **Plumbing Code:** Any equipment or piping that comes in contact with potable water must meet the potable water plumbing materials standards. (A WI Plumbing Products Approval is not required anymore.) The installation of the system that comes in contact with the potable water system must be installed by a properly credentialed plumber. A floor drain must be provided for the water heater, if the water heater is installed on the lowest floor level. If a heat exchanger is used and only food grade additives are used, it may be a single-wall heat exchanger. If non-food grade additives are used, then the heat exchanger shall be a vented, double wall heat exchanger as required by s. Comm 84.41(3)(d). The valving and safety devices on the system must comply with the Plumbing Code.
- **Nonpotable piping:** If the listing permits the installation of backflow prevention at the water heater inlet or isolation of the water heater, then non-potable material potable water materials may be used. Nonpotable, heat distribution piping standards are not specified in either code.
- **Backflow Protection:** If backflow protection is installed, then the buildings water system is no longer available for expansion of the heated water. The temperature-pressure relief valve must be selected in coordination with the backflow preventer. There needs to be an

expansion tank or other expansion means provided. These items, if allowed, shall be installed per the water heater's listing and Wisconsin plumbing code.

- **Isolated Water Heaters:** If a water heater is installed with no connection to the potable water system, then proper water expansion means shall be provided per the water heater's listing.
- **Pipe Insulation** - Per ss. Comm 22.44 and IECC 503.2.8, heating pipes shall be insulated to minimum R-4 when passing through unheated spaces [unless IECC 403.3 with R-2 applies].

Optional Uniform Dwelling Code (UDC) Makeup and Combustion Air Worksheet (1/12/09)

Project Address _____ Completed by: _____ Tel. _____

Background: The UDC applies to all one and two family dwellings built since June 1, 1980. Section Comm 23.02 of the UDC requires that outside **makeup air** be supplied to balance mechanical exhaust ventilation, including required bathroom fans, so that adequate air change occurs, without backdrafting of open combustion heating appliances. Section Comm 23.06 of the UDC requires that adequate **combustion air** be supplied to heating appliances for complete fuel combustion and flue gas venting purposes, which should minimize carbon monoxide hazards. This worksheet demonstrates compliance with both requirements.

If your dwelling does not have any open combustion appliances, then you do not have any **combustion air** requirements and, by code, can rely upon infiltration through building cracks for **makeup air**. Open combustion appliances are those which use air from within the dwelling for combustion.

NOTES: Typical appliance values are given in the tables, however use actual values if known.
Round pipe has the following areas: 3" dia. pipe - 7 sq in, 4" - 12 sq in, 5" - 20 sq in, 6" - 28 sq in, 8" - 50 sq in, 10" - 79 sq in, 12" - 113 sq in.
Opening Restrictions: If louvers or screening is provided on an opening, then multiply its gross area by the following factors to obtain the net area (alternatively, knowing the net area, divide to obtain the gross area): 1.0 for 1/4" hardware cloth, 0.8 for 1/8" screen, 0.75 for metal louvers, 0.5 for metal louvers and 1/8" screen, and 0.25 for wood louvers [per Comm 23.06(5)(c)].

A. Makeup Air - Complete the following table for exhaust fans, but not recirculating, whole house fans, attic fans or inlets of balanced ventilation systems.

Intermittent Exhaust Fans	**Typical Exhaust CFM**	**OR Actual CFM**	**Number**	**Total (cfm)**
Bathroom fan (min. 50 cfm)	75		x	
Resid. kitchen range hood	180		x	
Downdraft range exhaust	400		x	
Electric clothes dryer	175		x	
Gas clothes dryer	150		x	
			SubTotal	
			Intermittency Adjustment Factor	X .40
			Adjusted Total	
			Any constant exhaust fans without dedicated makeup air	+
			Net Grand Total Makeup Air Required	

You can provide makeup air via the following methods (check appropriate boxes). Note that openings or ducts shall be provided between the source of the makeup air and the exhaust fans.

- ☐ **Intake fans with a capacity equal to the Grand Total above.** If ducts are connected to the fan, the fan capacity shall be appropriately adjusted.
- ☐ **Openings to the outside, ducted to the return plenum of the furnace** to provide tempering and distribution. Multiply the Grand Total by the appropriate restriction factor for louvers or screening to obtain the gross makeup air required:

_____(Net Grand Total Makeup Air Required) ÷ _____ (Opg Restr. Factor) = _____ (Adjusted Makeup Air Reqd)

The calculated capacity for round intake duct is: 3" - 38 cfm; 4" - 69 cfm; 6" - 157 cfm; 8" - 279 cfm (Circle planned size)

Section Comm 23.02(3)(a)2. requires outside makeup air openings to have shutoff means of automatic or gravity dampering for periods when no makeup air is required. Because of this dampering requirement, you may **not** use makeup air openings for combustion air openings, which are prohibited to have dampers.

B. Combustion Air (Note that appliance manufacturer requirements may be more restrictive.)
There are several methods of providing combustion air, of which you will choose one for each group of appliances in a common space. First, complete the table **for open combustion appliances** on the next page to determine if you can comply with method 1 or 2, below, which allows at least some inside combustion air. Otherwise, choose another method from the next page.

1. Inside Air (Discontinuous Vapor Retarder): Allows combustion air to be drawn from an inside space if the building has a discontinuous vapor barrier, as is permitted at box sills by s. 22.38(2)(c)2. The space shall provide a room volume of at least 50 cubic feet per 1000 btu/hr combined input rating of all open combustion appliances in that space. **Room Interconnection**: An inside space may include several rooms if connected with **high and low openings**, with each opening providing one square inch of clear opening per 1,000 btu/hr input rating, but not less than 100 square inches each. Remember to apply the above Opening Restriction Factors for louvers on the openings.

Room Interconnection:

Net Sq. In Req'd at Input/1,000: _____ (Min. 100 in^2) ÷ ____(Opg. Restr. Factor) = _____sq. in. **each opg**;

Appliance	**Appl. Group Num-ber**	**Typical BTU/hr Input**	**Actual BTU/hr Input**	**Total BTU/hr in Each Numbered Group of Appliances That Share a Space**	**Room or Intercon-nected (per Method 1) Space Volume**	**Room Volume Divided by [Total BTU/hr in Room ÷ 1,000]***
Furnace □ Gas □ Other		100,000		Appl. Group 1		
Gas or Oil Water heater		50,000				
				Appl. Group 2		
Gas clothes dryer		35,000				
Gas fireplace		50,000		Appl. Group 3		
Gas range		65,000				
Wood stove or fireplace (Input per cu. ft. of firebox capacity)		100,000				

***If any room, or interconnected group of rooms, provide less than 50 cu ft per 1,000 BTU/hr of all appliances within, per the last column of the table, or the dwelling has a continuous vapor barrier, then choose one of the appropriate methods below. Enter the appliance group number in front of the applicable method. You can skip to Method 4 or 5 if the room is small and isolated.**

2. Inside & Outdoor Air (Continuous Vapor Retarder): If dwelling has a continuous vapor barrier, and therefore cannot use method 1 of taking all air from inside, but per the above table has a room volume of at least 50 cubic feet per 1000 BTU/hr combined appliance input rating, then provide supplemental outside air via a single, direct or ducted, exterior, high opening, sized at one square inch per 5,000 btu/hr combined input rating.

Appl Group# _____

Exterior Opening:

Net Sq. In. Required at Input/5,000: ____÷ ____(Opg. Restr. Factor) = ____sq. in.; Planned Opg. Dim.: ____

Room Interconnection:

Net sq. in. Req'd at Input/1,000: _____ (Min. 100 in^2) ÷ ____(Opg. Restr. Factor) = _____sq. in. **each opg**;

3. Single Outdoor Opening (Gas Appliances Only): If serving only gas appliances, then provide outdoor air via a single, direct or ducted, exterior, high opening sized at one square inch per 3,000 BTU/hr combined input rating, but not smaller than the combined cross sectional areas of the appliance flue outlets in that space.

Appl Group#

a. Sizes & areas of flues: _____ Total flue area:_____sq in.

_____ b. Net Sq. In. Required at Input/3,000: _____sq in..

Greater of a. or b.: _____ ÷ _____(Opg. Restr. Factor)= _____sq. in.; Planned Opg. Dim.: _____

4. Prorated Inside Air Credit Plus Outdoor Air: Calculate the pro-rated credit for an inside space that partially meets method 1, and then make up the difference by pro-rating the outside combustion air otherwise required by method 5. **Example:** If the inside space provides only 25 cubic feet per 1,000 BTU/hr (**per last column of table above**), or half of the size required by method 1, then the additional direct or ducted outside combustion air, as calculated by method 5 can be reduced by one half.

Appl Group#

_____

Pro-rating credit: **100%** - [_____ (Actual room vol. per 1000 BTU/hr) x 2)] = _____

5. Two Outdoor Openings: Provide outdoor air via high and low, direct or vertically ducted, exterior openings, each sized at one square inch per 4,000 BTU/hr combined input rating; or via horizontally ducted openings, each sized at one square inch per 2,000 BTU/hr combined input rating.

Appl Group#

□ Direct or Vertical Ducts: Sq In Required at Input/4,000: _____sq in x ___(Credit from 4.) = _____sq in.

_____ □ Horizontal Ducts: Sq In Required at Input/2,000: _____sq in x ____(Credit from 4.) = _____sq in.

Net Sq. Inches Required: _____ ÷ ____(Opg. Restr. Factor) = _____sq. in.; Planned Opg. Dim.: _____